PROCEEDINGS OF THE XI INTERNATIONAL CONGRESS OF EGYPTOLOGISTS

Florence, Italy 23-30 August 2015

MUSEO EGIZIO FIRENZE

Florence Egyptian Museum

edited by

Gloria Rosati and Maria Cristina Guidotti

Archaeopress Egyptology 19

INTERNATIONAL CONGRESS OF EGYPTOLOGISTS XI

Florence, Italy 23 - 30 August 2015

MUSEO EGIZIO FIRENZE
FLORENCE EGYPTIAN MUSEUM

Ministero dei beni e delle attività culturali e del turismo

Università degli Studi Firenze
SAGAS
Dipartimento di Storia, Archeologia, Geografia Arte e Spettacolo

CAMNES
Center for Ancient Mediterranean and Near Eastern Studies

Proceedings of the XI International Congress of Egyptologists

Florence Egyptian Museum
Florence, 23-30 August 2015

edited by

Gloria Rosati and Maria Cristina Guidotti

Archaeopress Egyptology 19

ARCHAEOPRESS PUBLISHING LTD
Gordon House
276 Banbury Road
Oxford OX2 7ED

www.archaeopress.com

ISBN 978 1 78491 600 8
ISBN 978 1 78491 601 5 (e-Pdf)

Cover: Giuseppe Angelelli, *The French-Tuscan Expedition to Egypt* (1828-29).
1830. Oil on wood, 230 x 347cm. Florence, Egyptian Museum.

Printed in England by Oxuniprint, Oxford
This book is available direct from Archaeopress or from our website www.archaeopress.com

Contents

Poster presentations

The folding cubit rod of Kha in Museo Egizio di Torino, S.8391

Naoko Nishimoto

Visiting Researcher, Musashino University, Japan

Abstract

Much may be inferred about item S.8391, a folding cubit rod that belonged to Kha (TT 8, 18th Dynasty), by analyzing the results of the measurement survey conducted in 2011 from the perspective of woodwork.

When Schiaparelli discovered the rod, it was folded inside a leather bag with a strap. The extremely rare folding cubit rod was loved by Kha, who was the overseer of works in Deir el-Medina and its related sites, where it was in practical use. This rod folds in half with a simple bronze hinge at the center; there are absolutely no inscriptions. The carved tally marks are only rough divisions into palms and the digits, and compared with other rods, the cubit measure is somewhat long, so the rod's precision was in doubt. However, a metrological argument concerning the differences in the values of the palms and digits is proposed based on the presumed manner in which the wooden rod was created and actually used. The rod's total length is 527.6mm, not greatly different from that reported by Senigalliesi in 1961. The size of each measurement interval, which Senigalliesi did not report, suggests how the rod was made. The tally marks are fine white lines; the left-hand palm is 75mm long, which is the common measurement of one palm, subdivided into four digits that vary little in size. Taking this into account, it is unthinkable that the makers lacked the ability to make tally marks accurately. The variations of values were supposedly caused by the process of creating the hinge. The center interval, including the hinge, is especially small, at (36mm + 36mm =) 72mm. For example, if we assume a play of about 3mm, a commonly used value, the center interval would become 36mm + 36mm + 3mm = 75mm. The inclination of the lines and the variations in size indicate that tally marks were etched in the closed position. S.8391 can also be used as a half-cubit measure in a closed position, and the first palm on the left side can measure digits. Traces of trial and error in remaking the hinge were found. In this study, I discovered that the clever hinge that makes this cubit rod possible satisfies two contradictory requirements to realize this rare folding rod. The appearance of this folding cubit rod, with no inscriptions and purely functional design, shows that it took incalculable effort to make it a prized instrument for the owner.

Keywords

New Kingdom; metrology; Thebes; woodworking; tools

Introduction

The design processes of ancient Egyptian woodworking by anonymous artisans, including problems with their tools, are very interesting from the architectural point of view. Among the most interesting examples of ancient woodworking are pieces of ancient Egyptian furniture authenticated since the 1960s.

Superb technical drawings of Egyptian furniture have been produced in the past. Pioneers such as Baker and Wanscher, who were originally furniture makers, have bequeathed richly illustrated and authored books (Baker 1966; Wanscher 1980). In the second generation, Fischer and Killen produced valuable drawings (Fischer 1996; 1980-1994. See Herrmann 1996 for additional discussion). In addition, Eaton-Krauss discovered and revealed detailed scale drawings by Segal, an architect, who stayed in Cairo and produced them in 1935 (Eaton-Krauss 1989: 80–6, figs 1–4; Eaton-Krauss 1995: 90–2, figs 1–6; Eaton-Krauss 1997: 180, 183–4, figs 1–3; Eaton-Krauss 2008: 150–172, figs 1–33). Fortunately, she deposited Segal's drawings and notes in the Griffith Institute. Lovera (Leospo 1988: 154, fig. 206; Leospo 2001: 48, fig. 43) and Nicola (Leospo 1988: 122, fig. 161; Leospo *et al.* 1989: 40–81, figs 5–11, figs 14–20, figs 40–42, figs 52–53; Leospo 2001: 17, fig. 2; Nicola 1983: 60–1, figs 2–8) also produced fine detailed drawings of items of woodwork stored in Museo Egizio di Torino. However, there are few sources that provide the essential information for a detailed study of woodwork design processes, such as the components' seam lines or the size and position of the wooden pegs used in joinery.

Against this background, since 2000, I have surveyed and measured the pieces of furniture in the intact collection belonging to the architect Kha and his wife Merit, which is stored in Museo Egizio di Torino (Curto 1984; Donadoni Roveri 1988; Leospo 1983; Meskell 1998; Russo 2012; Scamuzzi 1965; Schiaparelli 1927; Vassilika 2010). These items can be compared to those of King Tutankhamun. I believe that the Kha and Merit's furniture collection is important not only in the study of woodwork but also for investigating the relationship between furniture and social roles.

From the results of the measurement survey, I first make two-dimensional scale drawings, and then create an exploded view using axonometric drawings (Nishimoto 2000; Nishimoto 2012; Nishimoto 2014). I then use the component drawings to demonstrate the devotion and craftsmanship of ancient artisans through such aspects as the form, construction method, joinery, and differences in the materials of each component, as well as mechanisms such as locks.

These pieces of furniture frequently reveal signs of repair that show trial and error, and these signs of repair become keys to understanding noteworthy problem-solving processes. At that time, lumber was very scarce, and parts of other artifacts were frequently reused. We must pay attention when traces of reconstruction are found. Because craftsmen who handled precious lumber would have been honored to be entrusted with such careful work, signs of repair through trial and error show that it was unforeseeably difficult work, even if detailed plans had been made by experienced artisans.

The production process of Inv. No. S.8391, a folding cubit rod, may be inferred by analyzing the results of the measurement survey in 2011 from the perspective of woodwork. In the following paragraphs I would like to demonstrate how this rod was made, with the aid of scale drawings and diagrams.

The folding cubit rod

Among the artifacts excavated from the tomb of Kha and Merit, there is an especially important item, even among those stored in Museo Egizio di Torino: the wooden folding cubit rod thought to have actually been used by the architect Kha (Curto

1984: 210; Donatelli 1988: 162, fig. 223; Goyon *et al.* 2004: 386; Schiaparelli 1927: 80, fig. 47; Senigalliesi 1961: 27, 32–3, 52, figs 4, 14–7, Table III; St. John 2000: 30; Vassilika 2010: 78–9, 83). When Schiaparelli discovered it, this cubit rod was folded in a soft, tanned leather bag with handles. It is thought that Kha carried it with him at all times. His artifacts include several gifts from kings and high officials, indicating his social status. Kha made a name for himself in the age of Amenhotep II and is known for serving three generations of kings, including Thutmosis IV and Amenhotep III (Russo 2012: 23, 77–8; Trapani 2012: 159). His official position is inscribed on the leg of a folding stool, S.8509 (Baker 1966: 116, fig. 156; Curto 1984: 215; Killen 1980–1994, vol.1: unnumbered page, in a table listing the items of Turin Museum; Schiaparelli 1927: 114, fig. 94; Vassilika 2010: 103–5; Wanscher 1980: 21), and when one considers that the original purpose of this stool was for outdoor use, it seems to symbolize the position of overseer of the (construction) works at the Great Palace (Russo 2012: 74). Kha was neither royal, nor a nobleman. However, according to Russo, he was not only the supervisor of the artisans of Deir el-Medina who worked on the tombs in the Valley of the Kings, but also so special a person that his name was known outside Deir el-Medina as well (Russo 2012: 78).

Recognized examples of the folding mechanism in ancient Egypt include folding stools from the Middle Kingdom, and a great number have been discovered from the New Kingdom, aside from the aforementioned S.8509 (Baker 1966: 135–7, figs 195–9; El Gabry 2014; Killen 1980–1994, vol. 1: 40–3; pls 55-64; Wanscher 1980: 9–68). Others include a folding bed from the New Kingdom that King Tutankhamun carried on campaigns, which is a compact bed that features ingenious stacking and is stored in the Egyptian Museum in Cairo (Baker 1966: 104–5, figs 136–7; Carter and Mace 1923–1933, vol. 3: 111, pl. 32A; Desroches-Noblecourt 1963: 184–5, figs 107a, b; Killen 1980–1994, vol. 1: 33–4, pls 42–3, figs 15–7; Reeves 1990: 182; Nishimoto 2000. See also H. Carter's Card No. 586-3 stored in the Griffith Institute). A model of a folding bed from the New Kingdom, Met No. 20.2.13a-c (Hayes 1959: 203, fig. 118; Scott 1944: 23), is also known.

The extremely rare folding cubit rod was loved by Kha, and it was employed for practical use. The entire rod is divided into seven intervals, and the leftmost of these is subdivided into four. The folding mechanism is compact for carrying, its movements are smooth, and it is a pleasure to use.

On cubit rod S.8391, which folds in half, there are absolutely no inscriptions. The carved tally marks are only rough divisions of the palm and the digits, and the length of one cubit is somewhat long, so its precision was in doubt. For a long time, this rod was disregarded by experts as an artifact with limited archaeological information (Sliwa 1975: 39).

However, as we begin to re-examine how the cubit rod was actually used in the Valley of the Kings, a detailed inspection of the only practical folding cubit rod yet discovered is probably essential for obtaining source material when studying the design methods of artisans. Goyon describes the cubit rods for practical use, but among those, only this eccentric cubit rod is illustrated (Goyon *et al.* 2004: 386, fig. 497).

Observations

Figure 1 shows the measurement scale drawing of S.8391. The rod, 20mm wide and 15mm high, has a characteristic pentagonal cross-section with a beveled edge. The total length is 527.6mm, not greatly different from the measurement reported by Senigalliesi in 1961, which was 528.634mm (Senigalliesi 1961: 52, Table III).

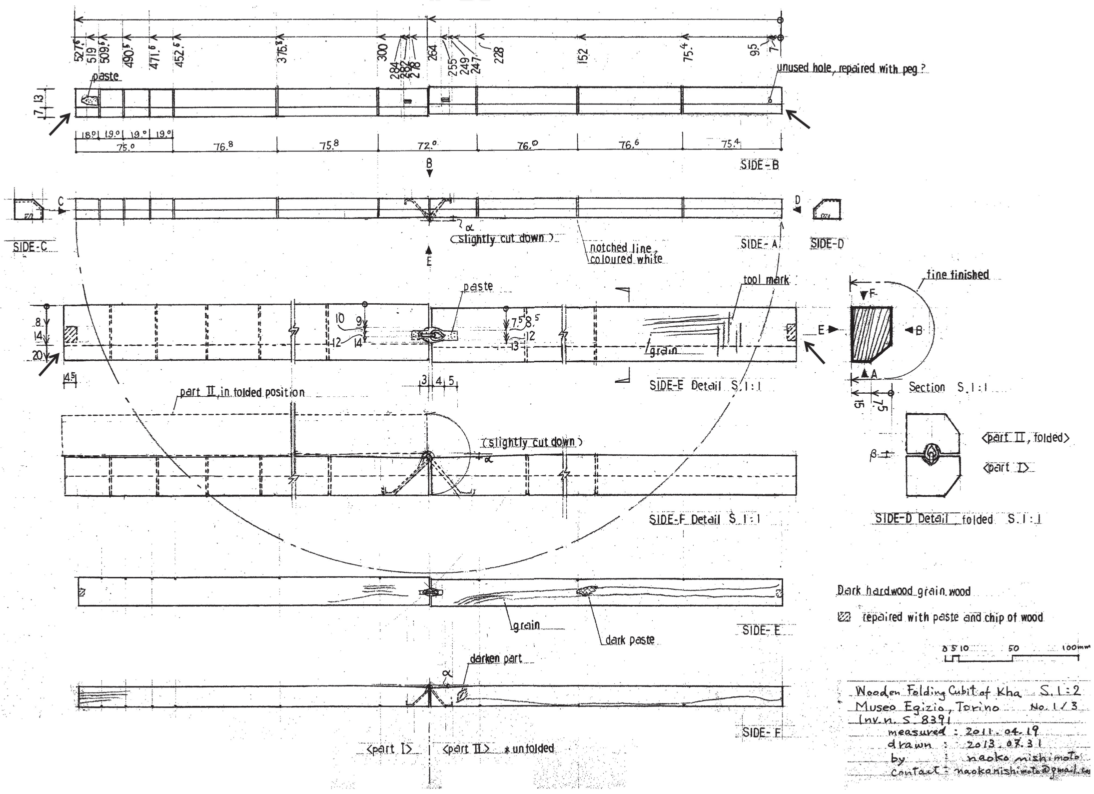

FIGURE 1: MEASUREMENT DRAWING OF FOLDING CUBIT ROD, INV. NO. S.8391, MUSEO EGIZIO DI TORINO.

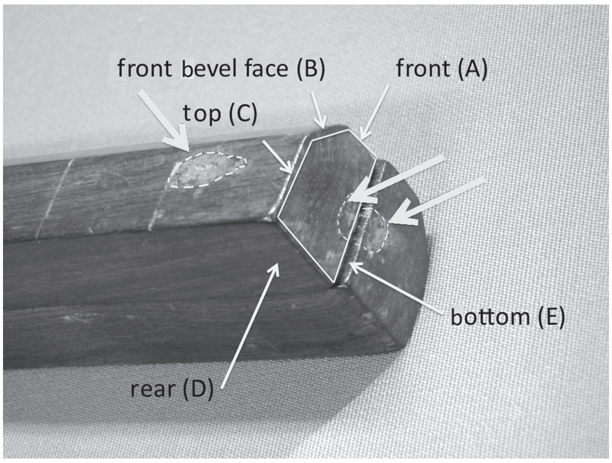

Figure 2: View of the end, in closed position.

Senigalliesi did not report the value of each measurement interval; therefore, I report the values for the first time here, as follows.

1st digit = 18.0mm
2nd digit = 19.0mm
3rd digit = 19.0mm
4th digit = 19.0mm

1st palm = 75.0mm (18mm + 19mm + 19mm + 19mm)
2nd palm = 76.8mm
3rd palm = 75.8mm
4th palm = 72.0mm
5th palm = 76.0mm
6th palm = 76.6mm
7th palm = 75.4mm

One palm is an average length of 75.37mm, and one digit is an average of 18.75mm.

The heavy, deep-maroon hardwood, acacia (Schiaparelli 1927: 80), is polished to a shine. The tally marks are notched lines, part of which have the remains of white pigment. With a clear, thin white tally mark on a hard and brightly polished dark-brown surface, it would have been very easy to see and use (Figure 2).

Museo Egizio di Torino also has Kha's gilt cubit rod, Inv. No. S.8647 (Curto 1984: 210; Russo 2012: 10–3; Senigalliesi 1961: 27 and 33–6, figs 5, 11, 18–24, Table III; Trapani 2012: 160–2, pl. 32.1; Vassilika 2010: 17), and the famous rod of Amenemope, Inv. No. 6347 (Curto 1984: 263; Donatelli 1988: 163, figs 220–1; Hirsch 2013: 34, fig. 7; Lorenzen 1966: pl. I; Senigalliesi 1961: 36–46, figs 6, 10, 13, and 25–30, Tables I, II and III), both of which have a pentagonal cross-section and are inscribed with hieroglyphs as votive rods. The total length of the gilt cubit rod is 523mm. This was a gift from Amenophis II.

The orientation of the cubit rod, from the hieroglyphs, is such that the front (A) as indicated in Figure 2 is an angled surface (Hirsch 2013: 15, fig. 2; Schlott 1969: 43). The subdivided palms of Amenemope's rod are on the right-hand side, but Kha's folding rod divides one palm into four digits on the left-hand side. The gilt cubit rod of Kha is also subdivided on the left-hand side. Although Kha's two rods have the left-hand subdivision in common, the two show considerable differences in the manner of segmentation.

On the folding cubit rod, the length of the leftmost digit is smaller than the others. Trapani stated with reference to the gilt cubit rod, 'Yet the engraving of the last palm is traced at a smaller interval in comparison with the others, so that it is likely that its width was determined by the total length of the cubit' (Trapani 2012: 161. However, note the careless confusion between Amenophis II and Amenophis III in conclusion; Trapani 2012: 167).

Construction of the folding cubit rod

An examination of the numerical measurements of the palms shows that the value of a palm interval on the left-hand end is 75mm, and the measurements of the remaining palms vary. These variations were supposedly caused by the process of creating the hinge. I will state my conjectural conclusions about the making of this rod and the construction of the folding mechanism based on the actual measurements of each interval of S.8391.

The values linked by arrows in Figure 3 have similar variations, showing the relationship of the point symmetry pivoting on the hinge in the center. From this, it is conjectured that the tally marks were notched in a closed position. It is also thought likely that this measure was also intended to be used when the rod was in a folded position.

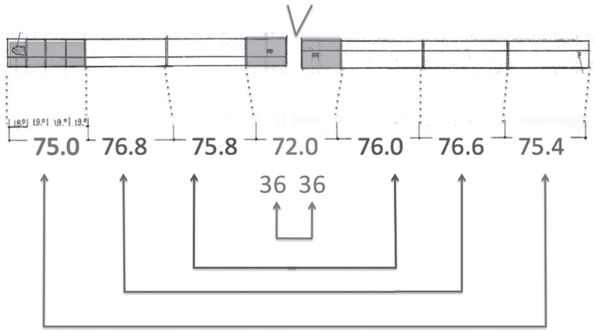

Figure 3: Assumed relationship between tally marks, based on size.

If the values from the left-hand side are aligned, the center interval, including the hinge, is especially small, at (36mm + 36mm =) 72mm.

75.0 / 76.8 / 75.8 / <u>36.0 / hinge / 36.0</u> / 76.0 / 76.6 / 75.4
(units in mm)

As mentioned above, the tallies are delicate white lines; the left-hand palm is 75mm, which is the common measurement of one palm, and it is subdivided into four digits whose values have little variation. Taking this into account, it is unthinkable that the makers lacked the ability to make tally marks accurately. So why are there variations in the values?

Perhaps the artisans, from experience, tried to allow play between the segments beforehand for the sake of the folding hinge, as shown in Figure 3. In woodworking terminology, play indicates an 'allowance' for dimensions, in this instance, the 'clearance' created to prevent the two segments of the rod from jamming against each other and interrupting its rotation. Even now, play is often prepared ahead of time for items that rotate. For example, if we assume a play of about

3mm, an often-used value, the center interval would become 36mm + 3mm + 36mm =75mm. Perhaps the center interval was reduced because the artisan made the tally marks while taking the play into account. For reasons I will discuss below, the result was that the space allowed for play was eventually closed, and the interval became too small. If so, how did the inaccuracy of the other intervals come about?

As for the production process for making a rod to be used as a one-cubit measure when open and a half-cubit measure when closed, it is thought that a one-cubit-long rod was first made, which was then cut in half, and finally the hinge was made. This time, to prepare the aforementioned play, the artisan had to decide where to include the play segment. In other words, there was an option to shorten the half-cubit measures by half the length of the play, or to have the one-cubit measure extended by the length of the play. It is thought that the makers used a method of making the whole rod on the long side. Because the center interval was shrunk only by the length of the play, as mentioned above, the play-sized part was divided within the half cubit. If it were used to take preliminary measurements of materials, for example in carpentry, the thickness of a blade saw would be lost, so there is a rationality to its being larger to allow for this width in measurements.

Clever hinge

Traces of repairs were found in the locations indicated by arrows on the top and on both ends (Figures 1 and 2). We cannot overlook the fact that the repair marks are clues to the knowledge of the artisans and the struggle for new designs at the time. These signs of repair clearly show that the hinge was remade, as I explain in detail below.

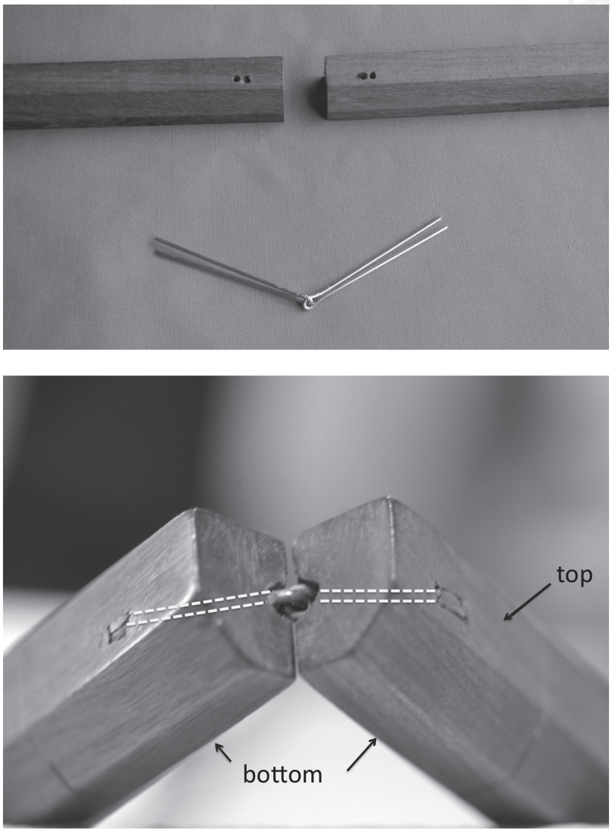

Figure 4: Hinge of the genuine rod and the hinge components of the trial reproduction (upper).

As shown in Figure 2, Surface D is the rear, and Surface E is the underside. Both are surfaces that touch the ground when the cubit rod is opened and when it is closed. Except for these two, all surfaces have tally marks etched on them. Except for the underside, all faces are polished to a shine. I will discuss below the traces of fine abrasions all across the underside. The hinge is made up of a pair of U-shaped wire loops (Figure 4). The top part of Figure 4 is a photograph of an attempted reconstruction of the cubit rod; to accommodate the hinge, it must have been necessary to create holes on the top of the hardwood rod in advance. A close inspection of the original hinge shows that the U-shaped wires were inserted toward the top surface from the underside corner of the rod; then their tips were bent and clinched into the rods just beneath the top surface (Figures 4 and 7). From observation, I realized that the locations of the repair marks visible on the top of the rod and the underside corners of the ends coincide with the locations of the hinge holes. It seems possible that the repair marks indicated by the arrows in Figures 1 and 2 are signs of trial and error from when the artisan reconstructed the hinge. We can surmise that the hinge of the folding cubit rod would have been an important issue for the craftsmen.

Because the hinge of the folding cubit rod in this study was diligently and repeatedly constructed through trial and error to satisfy two contradictory requirements, it is apparently unique among known rods from ancient and modern times.

First, I wish to summarize my observations about the folding mechanism. The axis of revolution must be placed on the outside of the rod for it to be folded. Perhaps this can be easily understood by looking at the hinge of any nearby door. If the axis of revolution is placed inside the thickness of the measure, the measuring rod will interfere with itself and will by no means be able to fold. On the other hand, if the hinge protrudes from the underside when the rod is open, it will rattle and be unstable. One can imagine that the architect Kha would not have accepted such an unstable and awkward instrument. Artisans who sought a rod with perfect contact even when open would have had to make it with a hinge that somehow does not protrude from the underside.

As shown by the arrows in the right side of Figure 5, the folding rod's axis of rotation is the contact point of the two wires composing the hinge. The axis of rotation must be placed on the outside in order to fold, but if it protrudes, it becomes a problem when in use. I suggest that this point was the most serious issue.

I consider that at the beginning, the intention was to set the axis of rotation as close as possible to the underside. However, despite only being 1.8mm thick, the wires would have protruded. This would have been a problem. I attempted to reconstruct it, and confirmed that even a protrusion of 1mm causes it to rattle, and while it is not completely unusable, its stability is impaired. Here we must bear in mind that the artisans by no means gave up on creating a good instrument for Kha. Whatever difficulties they had, they somehow tried to achieve their goal.

Regarding the experiment that the artisans may have conducted to fulfill two of the contradictory conditions, I have shown my conjecture in Figure 5.

First the hinge was set on the outside as in (1). I think that play was created as well. However, while (1) could fold, it became a problem because the hinge protrudes from the underside. It

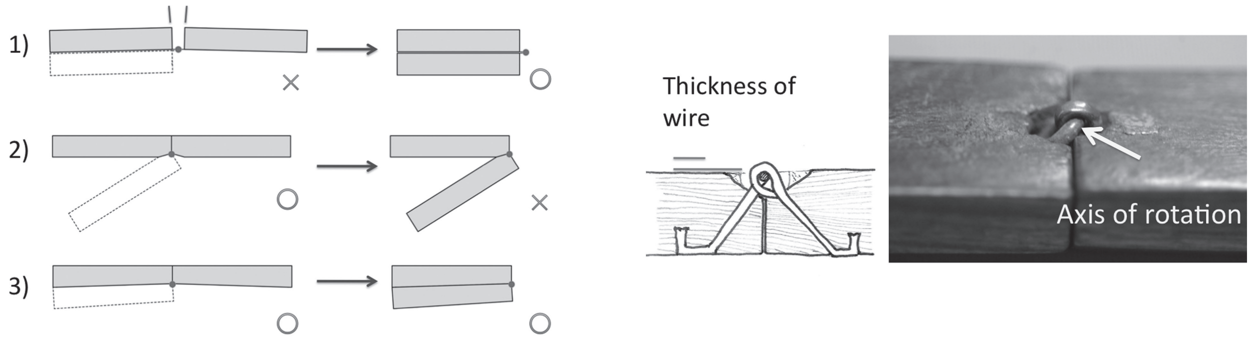

figure 5: assumed techniques used by artisans and view of the underside.

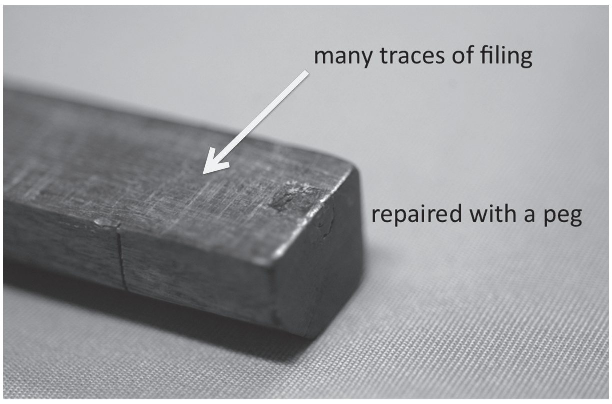

figure 6: view of the underside, left-hand aspect.

may be guessed that there were several subsequent attempts, but I conjecture that a gap was made by whittling the area around the hinge as shown in (2). Upon careful examination of the hinge surroundings, one can see that the edge of the measuring rod was slightly whittled. Nevertheless, this contradicts the principle of folding. The artisans whittled the area around the hinge and tried to embed the hinge into the thickness of the measuring rod, but because the axis of rotation was placed within the body of the rod, it could not fold and did not meet the essential requirement of being foldable. Thus, solution (3) was discovered. They created a slight gradient along the length of the underside toward the hinge.

When I observed the rod in the closed position, I noticed an extremely long and narrow triangle between the rods. It is conjectured that a slight slope, unnoticeable at first glance, was placed uniformly along the entire underside. Keeping the length of the rod and the thickness of the wires in mind, the gradient of the bottom surface is probably 2/1000 or 3/1000. When I made a scale drawing and simulated an actual rotation on paper, it became clear that the hinge would still require some improvement.

Upon further observation, I discovered that the loops of the wires used to make the hinge are slightly distorted. When I took this point into consideration, I succeeded in simulating rotation with method (3). I believe that the final key to solving the problem is the movement of the axis of revolution. The axis of rotation was moved slightly by the distortion of the loops. Figure 7 schematizes my conjecture concerning the principle of the clever hinge. I was thinking that I would like to create a model for verification, but when I asked artisan acquaintances, I was told that it is different from their usual work, and that they did not know how much time it would take to make the subtle adjustments. Currently I am waiting for a chance to make a reconstruction.

Finally, I would like to mention the signs of abrasion hidden on the underside (Figure 6). For the artisans to make the clever hinge, they would have needed to make a uniform and gentle slope on the bottom surface, but I imagine that this was done with a file because it was very delicate work (Killen 1994: 33; Lucas and Harris 1962: 449; Sliwa 1975: 38). I surmise that the countless abrasion marks are perhaps the traces of filing work. Regarding these abrasion marks, there is the explanation that they came about when Kha used the measure on top of stone. Certainly that is a possibility. However, there are almost no abrasions on the rear side, which could be considered a contact surface similar to the underside. Perhaps the reason for that must also be considered.

Yet, as with the rulers that we use every day, the special beveled surface with a pentagonal section is a useful shape

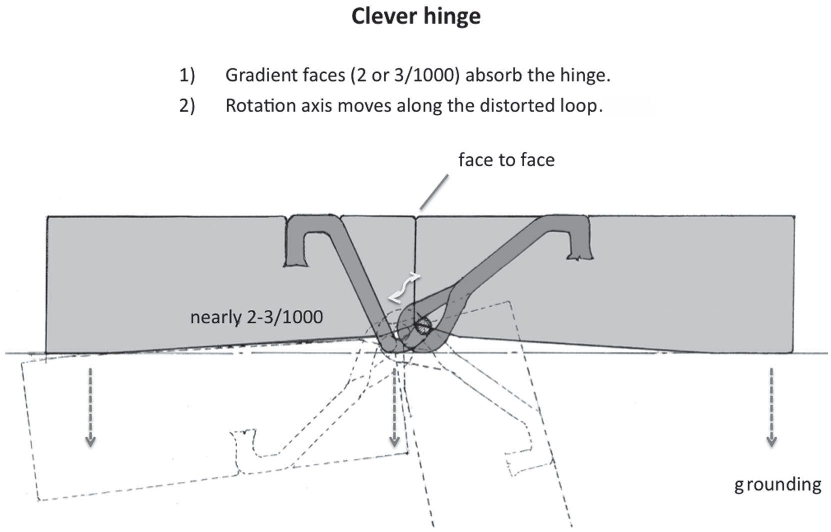

figure 7: diagram of the hinge design.

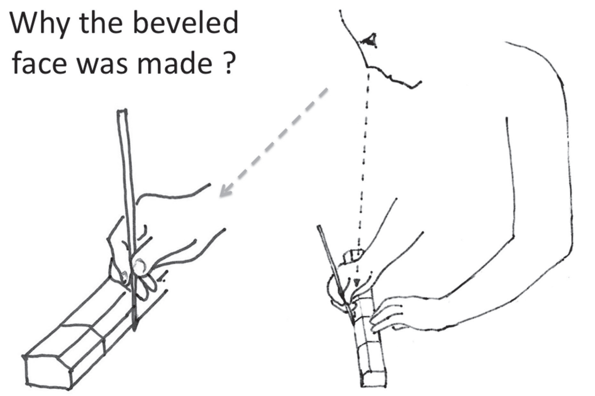

Figure 8: Function of the beveled face.

for making marks. Exactly as shown in Figure 8, it prevents the edge of the ruler from obstructing one's line of sight, and even when moving a hand holding a writing implement along the ruler it is easy to use and does not touch the edge. It may be that this was one reason for its pentagonal cross section.

Conclusion

I measured not only the total length but each interval of S.8391 and discovered traces of trial and error in remaking the hinge. I also stated points that suggest that the divisions, which were thought to be inaccurate, were caused by adjustments to the folding mechanism.

The folding rod is easy to use, either open or closed, and one can imagine Kha carrying it in his hand and using it at the destination site to measure approximate sizes. It can be used as a one-cubit as well as a half-cubit measure, and the first palm on the left side can measure digits, which indicates that this instrument was a prized possession that could also measure the dimensions of objects encountered in daily life. The numerical values of the length of the segments of rod vary according to how the ruler was used, thus illustrating the high degree of precision achieved by the Egyptian artisan.

In this study, I discovered that the clever hinge that makes this cubit rod possible meets two contradictory requirements to achieve the folding mechanism and to make the rod easy to use. As an instrument that Kha used on site, we can guess how important ease of use was, and we can recognize once again how special the owner of this tool was from the time and effort required to produce it.

As I mentioned before, King Tutankhamun has the unique folding bed. It is very interesting that among the artifacts of the architect Kha, who served the grandfather of Tutankhamun, there was already an item with a folding mechanism that was created with passion.

Acknowledgments

Regarding the measurement surveys at Museo Egizio in Turin, I would like to convey my deepest respect and gratitude to the successive directors Dr Anna Maria Donadoni Roveri, Dr Eleni Vassilika, and Dr Christian Greco for their cooperation. I greatly appreciated the patient cooperation of Dr Marco Rossani and Dr Federico Poole. In Japan, I would also like to express my gratitude for the cooperation of Dr Nancy R. Thomas, Professor Emerita of Art History, Jacksonville University, and Dr Yoshifumi Yasuoka, JSPS Research Fellow SPD, the University of Tokyo. I was grateful for advice during reconstruction from Mr Ikuru Suto, furniture designer for Ikuru design. I thank Mr Kazuki Sawada, Musashino University. This study is supported by a Grant-in-Aid for Scientific Research in Japan, No. 26580024.

Bibliography

Baker, H. S. 1966. *Furniture in the Ancient World: Origins and Evolution 3100-475 B.C.* London, The Connoisseur.

Beekman, W. B. 1949, Hoofstuk 7, Bossen, bomen en toegepast hout bij de Egyptenaren. In W. B. Beekman (ed.) 1949-1955, *Hout in alle tijden*, 6 vols, 1: 399–578. Deventer, Kluwer.

Caramello, S. 2013. Funny Inscriptions on Some Coffers of the Tomb of Kha. In A. Mengozzi and M. Tosco (eds), *Sounds and Words through the Ages: Afroasiatic Studies from Turin*: 283–92. Studi Umanistici, Department of Oriental Studies of the University of Turin Critical Studies 14. Alessandria, Edizioni dell'Orso.

Carter, H. and Mace, A. C. 1923–1933. *The Tomb of Tut-Ankh-Amen: Discovered by the Late Earl of Carnarvon and Howard Carter*, 3 vols. London, Cassell.

Curto, S. 1984. *L'antico Egitto nel Museo Egizio di Torino*. Torino, Tipografia Torinese Editrice.

Desroches-Noblecourt, C. 1963. *Tutankhamen: Life and Death of a Pharaoh*. New York, New York Graphic Society.

Donadoni Roveri, A. M. (ed.) 1988. *Egyptian Museum of Turin, Egyptian Civilization: Daily Life.* Milan, Electa.

Donatelli, L. 1988. Measuring Instruments, Tools, and Weapons. In A. M. Donadoni Roveri (ed.), *Egyptian Museum of Turin, Egyptian Civilization, Daily Life*: 160–87. Milan, Electa.

Eaton-Krauss, M. 1989. Walter Segal's Documentation of CG 51113: The Throne of Princess Sat-Amun. *JEA* 75: 77–88.

Eaton-Krauss, M. 1995. Note on Some New Kingdom Stools with Bull's Legs and Tutankhamun's 'Feeding Chair'. In C. Fluck, S. Richter, S. Schaten (eds), *Divitiae Aegypti: Koptologische und verwandte Studien zu Ehren von Martin Krause*: 85–92. Wiesbaden, Dr Ludwig Reichert Verlag.

Eaton-Krauss, M. 1997. Three Stools from the Tomb of Sennedjem, TT 1. In J. S. Phillips, L. Bell, M. R. Bell (eds), *Ancient Egypt, the Aegean, and the Near East: Studies in Honour of Martha Rhoads Bell*, vol. 1: 179–89. San Antonio, Van Siclen Books.

Eaton-Krauss, M. 2008. *The Thrones, Chairs, Stools, and Footstools from the Tomb of Tutankhamun*. Oxford, Griffith Institute.

El Gabry, D. 2014. *Chairs, Stools, and Footstools in the New Kingdom: Production, Typology, and Social Analysis.* British Archaeological Reports International Series 2593. Oxford, Archaeopress.

Fischer, H. G. 1996. *Varia Nova*. Egyptian Studies 3. New York, Metropolitan Museum of Art.

Goyon, J. -C., Golvin, J. -C., Simon-Boidot, C., Tinet, G. M. (eds) 2004. *La construction pharaonique du Moyen Empire à l'époque gréco-romaine: Contexte et principes technologiques*. Paris, Picard.

Hayes, W. C. 1959. *The Scepter of Egypt: A Background for the Study of the Egyptian Antiquities in the Metropolitan Museum of Art* II. New York, Metropolitan Museum of Art.

Herrmann, G. (ed.) 1996. *The Furniture of Western Asia: Ancient and Traditional. Papers of the Conference held at the Institute of Archaeology, University College London, June 28 to 30, 1993.* Mainz am Rhein, von Zabern.
Hirsch, A. P. 2013. *Ancient Egyptian Cubits: Origin and Evolution*. Unpublished PhD thesis, University of Toronto.
Killen, G. 1980–1994. *Ancient Egyptian Furniture*, 2 vols. Warminster, Aris and Phillips.
Killen, G. 1994. *Egyptian Woodworking and Furniture.* Shire Egyptology 21. Princes Risborough, Shire.
Killen, G. 1996. Ancient Egyptian Carpentry, its Tools and Techniques. In G. Herrmann (ed.), *The Furniture of Western Asia: Ancient and Traditional. Paper of the Conference held at the Institute of Archaeology, University College London June 28 to 30, 1993*: 13–20. Mainz am Rhein, von Zabern.
Killen, G. 1997. Wood Turning in Ancient Egypt. *Journal of the Tools and Trades History Society* 10: 10–25.
Killen, G. 2001a. Furniture. In D. B. Redford (ed.), *The Oxford Encyclopedia of Ancient Egypt* 1: 580–6. New York, Oxford University Press.
Killen, G. 2001b. Woodworking. In D. B. Redford (ed.), *The Oxford Encyclopedia of Ancient Egypt* 3: 516–9. New York, Oxford University Press.
Killen, G. 2002. John Garstang's Discovery of Wooden Furniture at Middle Kingdom Necropolis of Beni Hasan. In M. Eldamaty and M. Trad (eds), *Egyptian Collection around the World: Studies for the Centennial of the Egyptian Museum*, vol. I: 645–56. Cairo, Supreme Council of Antiquities.
Killen, G. 2002–2003. Woodworking in ancient Egypt. *Ancient Egypt* 3:2, 24–9; 3:3, 24–8; 3:4, 32–5.
Killen, G. 2012. *Ramesside Woodworking*, 2 vols. Unpublished PhD thesis, University of Liverpool.
Leospo, E. 1983. Manufatti egizi in legno: un problema di conoscenza e di intervento conservativo. In G. Tampone (ed.), *Legno nel restauro e restauro del legno: atti del congresso nazionale, Firenze, Palazzo Affari, 30 novembre-3 dicembre 1983*, vol.1: 57–72. Milano, Palutan Editrice.
Leospo, E. 1988. Woodworking: Furniture and Cabinetry. In A. M. Donadoni Roveri (ed.), *Egyptian Museum of Turin, Egyptian Civilization, Daily Life*: 120–59. Milan, Elacta.
Leospo, E. *et al*. 1989. Materiali lignei. In A. M. Donadoni Roveri (ed.), *Dal Museo al Museo: passato e futuro del Museo egizio di Torino*: 35–81. Torino, Umberto Allemandi & C.
Leospo, E. and Tosi, M. 1998. *Vivere nell'antico Egitto: Deir el-Medina, il villaggio degli artefici delle tombe dei Re*. Firenze, Giunti.
Leospo, E. 2001. *The Art of Woodworking*. Milan, Electa.
Lepsius, R. 1865. Die alt-aegyptische Elle und ihre Eintheilung. Berlin, Akademie der Wissenschaften. In M. St. John (ed.), *The Ancient Egyptian Cubit and its Subdivision*. London (2000), Museum Bookshop Publications (English edn.).
Lorenzen, E. 1966. *Technological Studies in Ancient Metrology*. Copenhagen, Nyt Nordisk Forlag.
Lucas, A. and Harris, J. R. 1962. *Ancient Egyptian Materials and Industries* (4th edition. First published in 1926). London, E. Arnold.
Meskell, L. 1998. Intimate Archaeologies: The Case of Kha and Merit. *World Archaeology* 29 (3): 363–79.
Nicola, G. L. 1983. Schede tecniche su sarcofagi Egizi. In G. Tampone (ed.), *Legno nel restauro e restauro del legno: Atti del Congresso nazionale, Firenze, Palazzo Affari, 30 novembre-3 dicembre 1983*, vol. 1: 59–62. Milano, Palutan Editrice.
Nicholson, P. T. and Shaw, I. (eds) 2000. *Ancient Egyptian Materials and Technology*. Cambridge, Cambridge University Press.
Nishimoto, N. 2000. The Folding Bed of Tutankhamun (in Japanese). *Mediterraneus: Annual Report of the Collegium Mediterranistarum* 23: 17–44.
Nishimoto, N. 2012. The Wig Box of Merit, Inv. No. S.8349, Egyptian Museum of Turin (in Japanese). *The Bulletin of Musashino University, Institute of Environmental Sciences* 1: 83–99.
Nishimoto, N. 2014. Recent Progress in the Research of Ancient Egyptian Furniture with Feline Leg: A Case Study on the Stool M00449 in the Middle Eastern Culture Center in Japan (in Japanese). *Mediterraneus: Annual Report of the Collegium Mediterranistarum* 37: 101–20.
Reeves, N. 1990. *The Complete of Tutankhamun: The King, the Tomb, the Royal Treasure*. London, Thames & Hudson.
Russo, B. 2012. *Kha (TT 8) and his Colleagues: The Gifts in his Funerary Equipment and Related Artefacts from Western Thebes*. Egyptology 18. London, Golden House Publication.
Scamuzzi, E. 1961. Notizie storiche su alcuni cubiti esistenti presso il Museo Egizio di Torino. *La Rivista RIV* 11: 18–22.
Scamuzzi, E. 1965. *Egyptian art in the Egyptian Museum of Turin*. New York, Harry N. Abrams.
Schiaparelli, E. 1927. *Relazione sui lavori della Missione Archeologica Italiana in Egitto (anni 1903–1920)* II: *La tomba intatta dell'architetto Cha nella necropli di Tebe*. Torino, Museo di antichitá.
Schlott, A. 1969. *Die Ausmaße Ägyptens nach altägyptischen Texten*. Darmstadt, Studentenwerk Darmstadt.
Scott, N. E. 1944. *The Home Life of the Ancient Egyptians: A Picture Book*. The Metropolitan Museum of Art Picture Books. New York, Metropolitan Museum of Art.
Senigalliesi, D. 1961, Metrological Examination of Some Cubits Preserved in the Egyptian Museum of Turin. *La rivista RIV* 11: 23–54.
Sliwa, J. 1975. *Studies in Ancient Egyptian Handicraft: Woodworking.* Krakow, Nakładem Uniwersytetu Jagiellońskiego.
St. John, M. 2000. *Three Cubits Compared.* Estoi, Privately published.
Tosi, M. 1999. Il valore in 'denaro' di un corredo sepolcrale dell'antico Egitto. *Aegyptus* 79: 19–29.
Trapani, M. 2012. Behind the Mirror: Art and Prestige in Kha's Funerary Equipment. In K. A. Kóthay (ed.), *Art and Society: Ancient and Modern Contexts of Egyptian Art: Proceedings of the International Conference held at the Museum of Fine Arts, Budapest, 13-15 May 2010*: 159–68. Budapest, Museum of Fine Arts.
Vassilika, E. 2010. *The Tomb of Kha*: *The Architect*. Torino, Fondazione Museo delle Antichità Egizie di Torino.
Wanscher, O. 1980. *Sella Curulis: The Folding Stool: An Ancient Symbol of Dignity*. Copenhagen, Rosenkilde and Bagger.
Williams, C. L. R. 1913. Egyptian Furniture and Musical Instruments. *BMMA* 8:4: 72–9.